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AGRICULTURAL Research

August 1965/Vol. 14, No. 2

Foundation for Natural Beauty

"The greatest service which can be rendered to any country," wrote Thomas Jefferson in 1790, "is to add a useful plant to its culture."

Among these plants are those that beautify.

Some of our earliest settlers brought seeds of ornamentals with them—for their "touch of beauty from the old country."

Although early plant explorers sought crop plants primarily, in recent years ARS explorers have searched the world for ornamental plants that will add beauty to our landscape. In cooperation with Longwood Gardens, Inc., nine explorations have been made since 1956 to the remotest areas of Asia and South America and to Europe and Australia. Hundreds of azaleas, chrysanthemums, camellias, hollies, evergreens, and exotic trees are finding their way into botanic gardens, experiment stations, and nurseries as a result of the explorations.

These introductions will decorate tomorrow's yards and gardens, parks, streets, and highways.

Many of the plants collected in Asia in the early 1900's by USDA's explorer Frank Meyer have contributed to a wide range of ornamentals that are only now finding a permanent place in beautifying America. The Chinese elm, ornamental willows, wild roses, and a flowering pear are among them.

The flowering pear (*pyrus calleryana*) has yielded a selection called Bradford that in 1962 was added to New Jersey's recommended list of shade trees for use along that State's streets and highways.

Zoysia lawn grass and several species of bamboo are now planted in some areas of the United States as a result of travels in Japan—after the turn of the century—by explorer David Fairchild. He also introduced the famous cherry trees to our Nation's Capital.

These and many other noted plant explorers have indeed rendered a great service to their country—by helping to provide some of the plants needed to beautify America. At no time in the history of this Nation have their efforts had such widespread public support.

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Orville L. Freeman, Secretary
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AUTOMATING IRRIGATION BY RADIO

*Engineers, soil scientists
develop inflatable valves
controlled by radio signals*

■ A completely automatic irrigation system—one that opens and closes valves at predetermined times—can conserve both water and labor on many western farms.

Soil scientist H. R. Haise and engineers E. G. Kruse and N. A. Dimick, all of ARS, have developed fully automated irrigation systems: One automates pipeline-irrigated fields; the other, open-ditch-irrigated fields. Agricultural experiment stations in Colorado, South Dakota, and Wyoming cooperated in the research.

The heart of each system is an inflatable valve made of nylon-reinforced butyl rubber.

In pipeline-irrigated fields, for example, the inflatable valve is an O-ring that is mounted between the seat and lid of an alfalfa valve and held in place by a metal sleeve that slides up and down the valve stem. When the valve is open, or deflated, the O-ring washes against the alfalfa valve lid so that it rides on top of the water flowing from the pipeline. When the valve is closed, or inflated, the O-ring seals the opening by filling the space between the alfalfa valve seat and lid.

In open-ditch systems, the inflatable valve is a tube with sealed ends that is fastened in a turnout pipe. When

deflated, the tube lies flat in the turnout pipe. When inflated, it blocks the flow of water through the turnout pipe.

Both systems can be controlled from the farm house. In a typical installation, a 24-hour preset timer and a set of stepping relays turn on a 12-channel, citizens-band radio transmitter. The transmitter beams activating signals to individual inflatable valves.

At the individual valve, a battery-powered radio receiver, tuned to one

of the transmitter's channels, receives the signal to open the valve. A relay in the receiver activates a solenoid that deflates the valve, and allows water to flow from the pipe.

After the water flows for a predetermined irrigation period, the clock timer and relays again activate the transmitter, and it signals the receiver to close the valve.

The relay in the receiver trips the air-control device, and compressed air—pumped to each valve in flexible



Radio signal is transmitted automatically at a preset time to individual receivers at irrigation valve outlets. The receiver activates the pneumatic valve, either starting or stopping the flow of water into irrigation ditches.

AUTOMATING IRRIGATION BY RADIO

(Continued)

polyethylene tubing—inflates the valve and stops the flow of water.

This system can also be operated remotely with a timer and relays that send signals through a pair of wires to the individual valves. And by adding one electrical wire to the two signal wires, the need for batteries to activate the receivers and solenoids can be eliminated.

The scientists have field tested the automated system at Newell, S. Dak., and in western Wyoming, but it is still about a year from the commercial market. They plan to test several modifications, such as replacing the polyethylene air-distribution lines with nylon-reinforced garden hose, and using water, possibly, instead of air to inflate the valves.☆

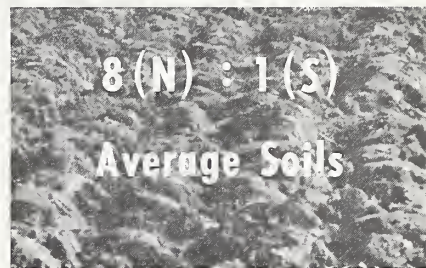
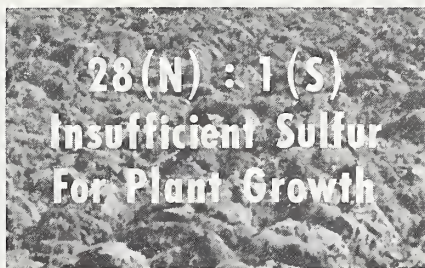
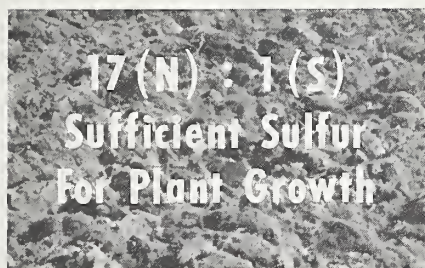
Conventional alfalfa valve with lid removed (upper left) is ready for pneumatic valve installation (upper right). Once valve is in place, lid is put on (lower left) and valve is inflated (lower right) so that water can flow into tile line. At a signal from transmitter, the valve will deflate and water will surge into irrigation ditches.



The 24-hour timer (left) and a set of stepping relays turn on a tone transmitter (right). The transmitter beams signals to receivers at each valve outlet.

NITROGEN : SULFUR

In decomposing residue, soil organisms can cause an imbalance, reduce crop yields



■ Crop-residue management challenges dryland wheat farmers and scientists alike. Left on the surface, as in stubble mulching, residues effectively curtail wind and water erosion. But sometimes, especially in years of above-normal rainfall, they decrease grain yields as well—and even a small yield decrease is important to a farmer with a small profit margin.

Adding nitrogen fertilizer to mulched fields usually minimizes yield decrease but rarely eliminates it.

In recent tests, ARS researchers pinpointed part of the reason for the failure of nitrogen to overcome yield decreases: The micro-organisms that decompose wheat-straw residue use soil sulfur as well as nitrogen for food, causing an imbalance in the nitrogen-to-sulfur ratio in the soil.

In basic research at Fort Collins, Colo., ARS soil scientists B. A. Stewart and C. J. Whitfield analyzed the effects of wheat-straw decomposing in soil. The Colorado Agricultural Experiment Station cooperated in the work.

Wheat straw was mixed in soil from a summer-fallowed field at a rate about equivalent to $1\frac{5}{8}$ tons per acre. The soil-straw mixture was placed in containers and incubated at constant temperature for 2 weeks. Then winter

wheat was planted in the containers, allowed to grow for a month, and cut.

Wheat grown in the soil-straw mixture yielded considerably less vegetation than wheat grown in containers of plain soil. Addition of nitrogen fertilizer increased yield in the soil-straw mixture more than in plain soil, but yields were still highest in the soil without straw.

When sulfur was added with the nitrogen, plants grown in the soil-straw mixture yielded as much as the check plants, indicating that the added sulfur replaced the available soil sulfur being used by the micro-organisms in decomposing the straw.

Plants with sufficient sulfur for normal growth had a ratio of about 17 parts nitrogen to 1 part sulfur in the tissue.

Plants fertilized with nitrogen but not sulfur had an average nitrogen-to-sulfur ratio of 28 to 1; this lack of sulfur limited the formation of plant protein and caused nonprotein nitrogen compounds to accumulate in the tissue.

The researchers point out that the ratio of nitrogen to sulfur in soil organic matter varies with soils, but it averages about 8 parts nitrogen to 1 part sulfur. The 8-to-1 ratio is about the same in both virgin soils and cul-

tivated soils—a fact suggesting that when organic nitrogen and sulfur in the soil are converted to minerals, a plant can use them at the same ratio as they naturally occur.

By comparing the nitrogen-to-sulfur ratio in plant tissue with that in soil organic matter, the scientists drew a conclusion that may prove to be a reliable guide for farmers. Because they found proportionately more sulfur than nitrogen in the soil-matter than in the plant-tissue, and because nitrogen and sulfur are mineralized in about the same ratio as they occur in soil matter, any soil that supplies adequate nitrogen for crop production probably supplies adequate sulfur.

The ratios are similar enough to suggest that soils responding significantly to nitrogen fertilizer probably need additional sulfur too. Other natural sources of sulfur—irrigation water, rainfall, sulfur salts in the soil—may supply this need; the availability of additional natural sulfur depends on the soil and its location.

The results of this investigation also explain why legumes respond to sulfur fertilization (AGR. RES., June 1960, p. 7). By fixing atmospheric nitrogen in the soil, the scientists say the legumes upset the natural nitrogen-sulfur ratio.☆

WHAT MAKES HEAT TOLERANCE?

Dairy husbandmen disprove some long-held notions, seek practical indicators

ABOUT THE COVER—Dairy specialist A. J. Guidry uses an automatic monitor in the artificial climate laboratory to check rectal and ear temperatures, depth and rate of breathing, and heart action in high humidity and temperature tests.



■ Dairymen long have held notions about what makes a cow tolerate heat, but most of these notions are off base, ARS scientists have found.

One such fallacy involves physical characteristics of Indian cattle. Tough but relatively unproductive, these cattle have a big hump on the shoulder, a large dewlap, and long ears—all trademarks of heat tolerance, it was thought.

The Indian cow, so the fallacy went, carries fat in her hump instead of spreading it all over her body where it interferes with the cooling system. Her dewlap and big ears, according to the old story, work like a radiator. When the animal gets too hot, the body causes blood vessels in the skin to dilate to get rid of more heat.

Checking into the old beliefs, dairy specialist R. E. McDowell and other ARS scientists found that the hump of Indian cattle contains no more fat than other fleshy tissues of the back. In fact, bulls of English breeds have tissues similar to those that form the hump of Indian cattle, but instead of standing erect, the tissues are stretched along the top of the neck.

In heat tolerance tests, Sindhi bull—without dewlap, hump, and long ear tips—performed about the same as a normal bull of the same breed. These results ruled out former belief that external structures aid in coping with high temperatures and humidity

The dewlap and ears turned out to be poorly equipped as a radiator, since there are far fewer blood vessels in these extra skin areas than in skin covering other portions of the body.

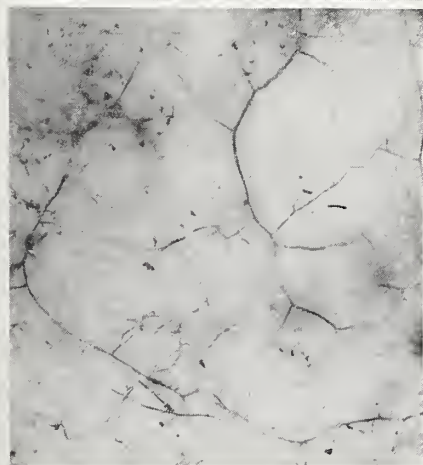
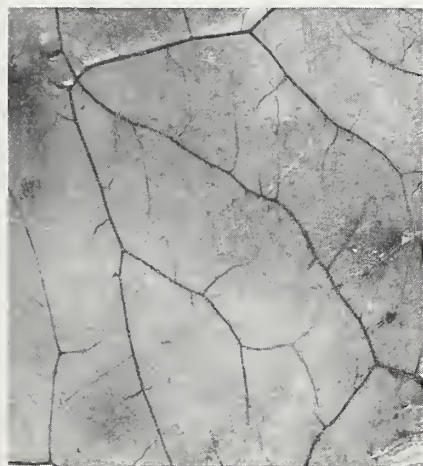
To demonstrate the fallacy of the “fat and radiator” theory even more clearly, ARS researchers removed the hump from Indian cattle by surgery, cut away the extra skin folds in the dewlap, and trimmed the ears to the size for Jerseys. The streamlining caused no measurable lowering of heat resistance.

Other widely held notions examined by ARS ranged from dead wrong (“English breeds lack sweat glands”) to off base (“white hair coats help beat the heat”). Actually, all cattle can sweat and hair color makes little difference. Skin color, however, helps some—but it is the *black* coloring that’s preferable, because it avoids sunburn.

The most heat-resistant cow, it turns out, sweats profusely and proficiently, carries a short summer haircoat, and has an oily skin. Indian cattle have

a higher group-average score than English breeds on all these counts; but some individual English animals have the same effective defenses against heat as the best of the Indians.

In theory, all that remains to be done to get heat-tolerant lines is to interbreed animals with the desired characteristics. But present tests are far too cumbersome to screen large numbers of cattle for traits that help them cope with heat. ARS scientists are currently searching for practical indicators on which a breeder can base his selection.☆



A well-defined network of blood vessels in the skin (top) rids the body of heat somewhat similar to a radiator keeping an engine cool. Blood vessels in the dewlap (bottom) are too small and too few to do much good.



Temperature BY EAR

■ ARS scientists “play it by ear” when they want to take a cow’s temperature. They use a newly designed thermometer fitted into the animal’s ear canal to help find reasons for reduced milk production during hot weather.

Medical researchers have found the ear thermometer more reliable than the rectal thermometer to measure the effect of heat on humans. ARS dairy husbandman A. J. Guidry and research dairy husbandman R. E. McDowell thought the ear thermometer might be equally useful for related dairy cattle research.

To adapt the ear thermometer to their needs, the scientists studied the cow’s ear carefully and fashioned a flexible probe that reaches 4½ inches into her ear—within one-eighth inch of the ear drum, or tympanic membrane. This explains the new tool’s scientific name: tympanic thermometer.

The cows did not seem to mind the tympanic thermometer; once the thermometers were in place, they showed no sign of discomfort.

Closeness to the ear drum is a major advantage of the tympanic thermometer for heat-stress research. The ear drum provides the most practical approach from outside the body to the hypothalamus, the organ at the base of the brain

where all body reactions to heat are believed to originate. When the barn temperature changes, the ear thermometer quickly shows the resultant change of temperature in the body to which the hypothalamus would respond.

During a recent test, tympanic thermometers remained in cows’ ears for as long as 7 hours. ARS technicians took ear temperature readings every 2 minutes while they cycled air temperature in the experimental barn from 65° to 112° F. and back to 65°.

To the scientists’ satisfaction, tympanic measurements sensed changes as minor as one one-fiftieth of a degree Fahrenheit. Ear temperature proved to be highly responsive to changes of temperature in the barn and undisturbed by temperature fluctuations caused by passage of waste material. These temperature fluctuations distort readings made with a rectal thermometer.

Body temperature is, of course, only one of the reactions Guidry and McDowell measure when they increase the heat in the barn. They also check functions such as breathing, blood pressure, sweating, and digestion—in a continuing effort to discover ways to keep cows as productive as possible despite hot weather.☆

GUARDING AGAINST SEAFAR

“Inspectors PQ” comb ship holds to prevent beetles’ entry into United States

■ The constant struggle against insect enemies takes ARS plant quarantine inspectors into cramped, dark corners of ships’ holds and storerooms in search of khapra beetles.

It is their job to detect and eliminate this insect—one of the world’s worst and most elusive pests of stored grain—before it can reenter the United States.

The khapra beetle is found throughout much of Asia and Africa and in parts of Europe. Its discovery, in the Southwestern United States in 1953 prompted an eradication program that has cost State and Federal Governments \$11,000,000. At present, all known U.S. infestations have been fumigated or have been scheduled for

immediate treatment.

The khapra beetle threatens reentry at dozens of U.S. ports each year, including several on the Great Lakes that are uncomfortably close to the major grain-producing and storage areas. Last year, ARS plant quarantine inspectors intercepted the beetle 368 times at ports of entry. In all, 63 ships, including 5 calling at Great Lakes ports, were fumigated because of khapra beetle infestations, and 210,608 bags, bundles, and bales of cargo were also treated.

The search for the khapra beetle aboard ships is complicated by the insect’s tiny size and its ability to survive for years without food, which allow it to hide in cracks and crevices



aboard ship and in nonagricultural cargoes. It has been found, for example, in shipments of steel, lumber, and crude rubber—even in kegs of nails that were shipped in infested holds. How ARS inspectors seek, and find, this tiny pest in the expanse of a ship’s hold, or in cargo being unloaded, is shown in the accompanying photographs.☆



Telltale residues in cracks deep in a ship’s hold indicate to the inspectors that the ship has carried grain at some point in its history. Good light and sharp eyes are needed to detect this tiny and very elusive insect.

Debris from the cracks and crevices can best be examined by spreading it on a white sheet and then sorting through it carefully.

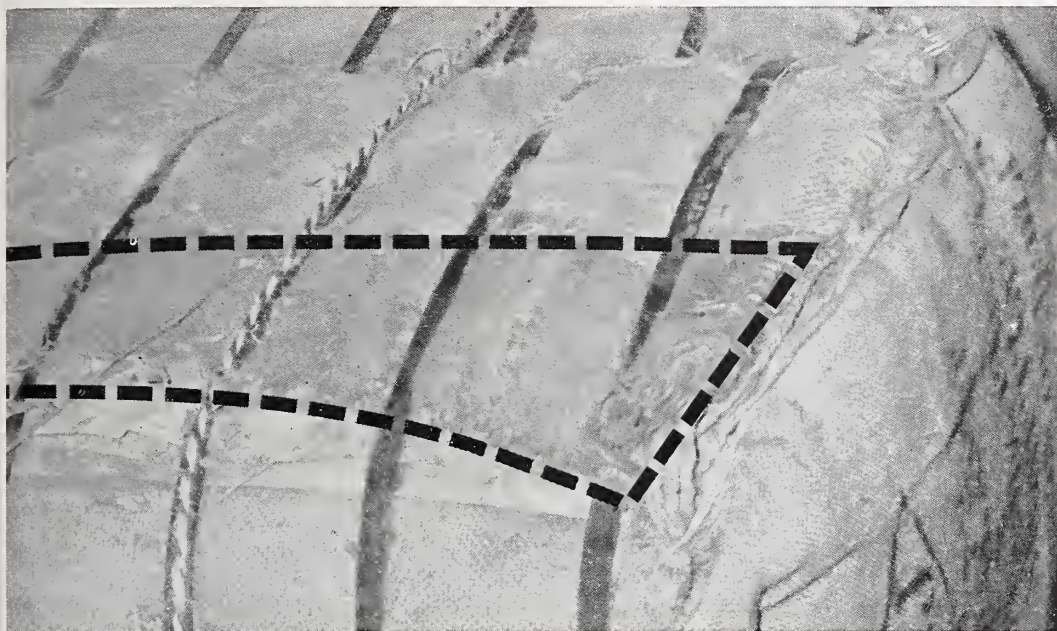
ING KHAPRAS



This tiny pest, considered by inspectors to be the world's most elusive, was intercepted 368 times at U.S. ports of entry last year. The beetles are a tenth to a fifth of an inch long; the larva, about a fourth of an inch.

LEFT—This ship, ready to unload at a U.S. port, is inspected to make certain its cargo and holds are free of khapra beetles, which could spread and infest U.S. grain-storage facilities.

BELOW—Used burlap is a common source of khapra beetle infestation. Parts of this bale wrapper came from old sacks that once contained infested grain. Months later, larvae lingered in the burlap.



Sesame seeds, carried on a previous voyage, were heavily infested with khapra beetles. ARS inspectors found the pests in seeds in cracks between lumber, making fumigation of the cargo necessary.

BOTTOM LEFT—This steel wire, and the ship it arrived on, had to be fumigated. The insects had entered the ship's hold months earlier when the vessel was carrying peanuts from Africa to Europe.

BOTTOM RIGHT—A ship's storeroom must be carefully inspected. Khapra beetles can infest the commodities used to feed the crew. They may even lurk in the folds and seams of sacks that contain the supplies.



HOW NEAR ARE VIRUS INSECTICIDES?

Scientists test effectiveness, safety, and feasibility of viruses that attack major insect pests

■ Scientists at Beltsville, Md., have encouraging results that could lead to the first registration of an insect virus for use to control insects.

They are optimistic, in fact, that a virus of the cotton bollworm, corn earworm, and tomato fruitworm and a virus of the tobacco budworm will meet Federal standards—be effective and safe when used as recommended. Final tests to establish safety to man, however, have not yet been completed.

The scientists believe that—once approval is given to manufacturers—a freeze-dried preparation of the virus could be produced at a price that is competitive with chemical insecticides.

Studies have shown that viruses are the most promising of several types of micro-organisms that cause diseases in natural insect populations. Although no virus has been approved as yet for control of insects, two bacteria—*Bacillus thuringiensis* and *B. popillae*—have been approved. *B. popillae* is best known for the control of Japanese beetles.

The Beltsville scientists have (1) proved the effectiveness of viruses as insect-control agents under field conditions, (2) determined their safety with respect to other forms of life, (3) developed a method for mass rearing the viruses, and a bioassay to determine their commercial potency and virulence. (See "A Microbial War on Insects," AGR. RES., September 1964, p. 3; and "Natural Insecticides," AGR. RES., November 1964, p. 3.)

The mass-production method was used to obtain large amounts of virus for recent field tests. In this process, insects are infected with a virus of the nuclear polyhedrosis type. This

virus develops in the cell nucleus, where it multiplies and prevents the cell from performing its normal functions. The virus particles cluster together and become covered with protein to form a polyhedron, a chemically inert, many-sided body.

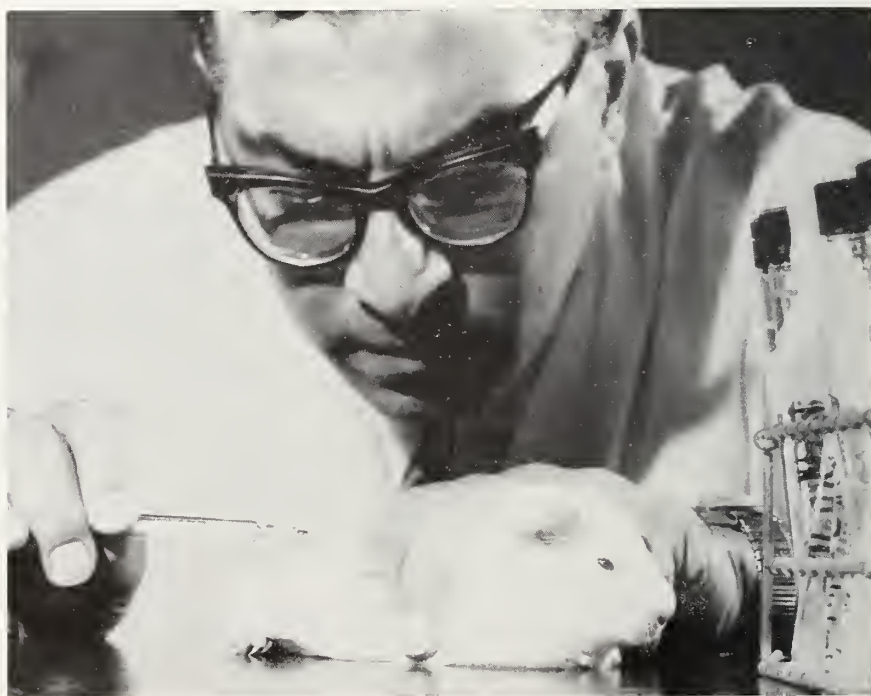
Once these polyhedra have been fed to insect larvae, they multiply at a phenomenal rate; each larva can produce billions of polyhedra. These polyhedra eventually kill the larvae, which are then processed to obtain virus for use against insects in the field.

ARS entomologists C. M. Ignoffo, A. J. Chapman, and D. F. Martin

treated grain sorghum, corn, and cotton with an insect virus of *Heliothis zea*, the cotton bollworm (also called the corn earworm and the tomato fruitworm). They also treated cotton with an insect virus of *H. virescens*, the tobacco budworm. These two *Heliothis* species are considered the most serious pests of U.S. cotton.

The researchers obtained excellent control of the cotton bollworm on grain sorghum with only one application of virus at a rate of 166 infected larvae per acre. In corn, they achieved a "highly significant reduction" of earworm by applying the virus several times at a rate of 100

Entomologist C. M. Ignoffo injects a guinea pig with nuclear polyhedrosis virus in toxicity tests. None of the test animals, which also included white mice, displayed any abnormalities, pathological conditions, or interruption of normal growth or health from exposure to the virus.



Cold Tolerance in Sugarcane

larvae per acre. And this same treatment in cotton was as effective as recommended insecticides in controlling bollworms and budworms.

The viruses were also tested to determine what effect they might have on forms of life other than their insect hosts. A. M. Heimpel, director of the ARS Insect Pathology Pioneering Research Laboratory, and Ignoffo exposed white mice and guinea pigs to the nuclear polyhedrosis virus of *H. zea* and *H. virescens*.

No deaths occurred among 102 virus-treated mice and only 1 death (diagnosed as pneumonia) occurred among 53 virus-treated guinea pigs. There were no deaths among 60 untreated mice and 15 untreated guinea pigs used as controls. No abnormalities, pathological conditions, or interruption to normal growth and health were detected in any of the experimental animals.

The researchers estimate that the highest dosage given the test animals would be equal to dosing a 150-pound man with the virus produced by nearly 4,800 larvae.

Those toxicity tests support a view long held by the researchers—that the viruses infect only the *Heliothis* species. Even though these diseases occur naturally in insects on field crops, where other forms of life are exposed to them, no infections have ever been reported in man, animal, or insects—other than in the target insect.

Nevertheless, before final approval can be obtained, it will be necessary to undertake toxicity tests on man under controlled conditions to assure that there will be no adverse effects.

The investigators say that additional research might expand the current list of insects to more than 200, which can be controlled by this biological method.☆

■ ARS scientists are speeding up the testing of sugarcane varieties for cold tolerance by using artificial freezes and northern plantings.

Freezes in the sugarcane-growing areas, although infrequent, cause considerable loss from frozen mill cane, frost damage, and poor regrowth from stubble. In Louisiana, frozen mill cane amounted to 200,000 tons in 1962 and 100,000 tons in 1963.

Cold tolerance can be divided into three phases: (1) Resistance of stalk tissue to freezing and subsequent deterioration of juices, (2) resistance of leaves and buds to frost damage, and (3) ability of cane to regrow from stubble after severe winters.

Sugarcane producers need varieties that are outstanding in all three phases of tolerance. But this has been difficult because experimental varieties are usually tested in the sugarcane growing areas, where freezes occur very infrequently. And a variety may be in advanced testing before temperature drop low enough so that its cold tolerance can be evaluated.

Scientists say that using artificial freezing chambers and locating test plots farther north will permit continuous cold-tolerance evaluation and cut the time and cost of developing improved varieties.

Meridian, Miss.—where severe freezing temperatures occur each year—has been chosen as the site for evaluating the cold hardiness of new sugarcane breeding material under development at the ARS Canal Point, Fla., research station. Preliminary tests at Meridian show that stubble stands are reduced by low temperatures and that varietal differences in stubbling may exist.

In addition, new importations and untested clones of species and hybrids from Canal Point will be evaluated for cold tolerance at Meridian. Varieties that show some cold tolerance then will be tested further under laboratory and field conditions in Louisiana and Florida.

At the U.S. Sugarcane Field Station, Houma, La., scientists devised methods of testing cane for resistance to stalk freezing and frost damage. ARS physiologist J. E. Irvine, research leader, says results obtained compare favorably with those under field conditions.

To test a variety for resistance to stalk freezing, the scientists place 10 large, mature stalks in a freezing room, at a temperature of 23° to 24° F., for 9 hours. Then the frozen stalks are thawed, shucked, and split. The water-soaked frozen tissue is cut off, and its weight is compared with that of unfrozen tissue. Up to 50 varieties are evaluated yearly with this method.

To test for frost resistance of leaves and buds, the scientists remove test plants from an unheated greenhouse and place them in a freezing room, where they are exposed to an artificial frost. Over 1,500 plants of Canal Point and Louisiana 1961 and 1962 assignments have been tested by this method, and many of these varieties had as good or better resistance than C.P. 44-101 and C.P. 46-115, used as checks. Varieties having satisfactory resistance are then evaluated at Meridian for stubbling.

Irvine says resistance to frost damage may have to come from introduced lines, since no commercial variety tested thus far has shown outstanding resistance.☆

Scientists Test Two New Biological Controls

* MARIGOLD COVER CROP IS PROMISING

■ The South American marigold (*Tagetes minuta*) is the most promising of seven plant species evaluated in Georgia and Alabama for their effectiveness in reducing populations of plant-parasitic nematodes in soil.

This species of marigold grows wild in the Southeastern United States and many other parts of the world. The plant is generally regarded as a weed, but in Southern Rhodesia, Africa, growers use it to reduce root-knot nematodes in tobacco fields.

Other crops evaluated were crotalaria, beggarweed, hairy indigo, sudangrass, millet, and coastal bermudagrass.

ARS nematologists and soil scientists cooperated with the Georgia and Alabama Agricultural Experiment Stations in the evaluation studies, which are part of continuing research to find nematode-resistant cover crops that can be grown in cropping systems used in the South.

Southern farmers badly need cover crops that will reduce nematode populations to low levels before susceptible crops are planted. The pest declines in the absence of host crops but quickly builds up to destructive levels when susceptible crops are grown. Many cover crops in common use are resistant to some species of nematodes, such as the root-knot nematode, but not to others.

Ideally, a nematode-reducing crop would have resistance to both endoparasitic (root-knot, root-lesion, etc.) and ectoparasitic (sting, stubby-root, lance, etc.) nematodes.

After marigolds were grown 1 year, in the Georgia-Alabama tests, 302,000 good-quality tomato plants were produced per acre; after crotalaria,

253,000 plants per acre; and after sudangrass and beggarweed, respectively, only 23,000 and 6,000 plants per acre. No marketable plants were produced after millet.

Under south Georgia conditions, marigolds grew 6 to 7 feet high, with dense foliage that provided good ground cover for approximately 9 months. Marigolds flower late in the season and set seed just before the first frost in November. The crop can be destroyed before frost to prevent seed production and possible undesirable voluntary seeding in succeeding crops.

The marigolds were drilled and cultivated once or twice to control early-season weeds. Late-season weed growth is suppressed by the dense shade under the crop, giving the pure stand of marigolds needed for effective nematode control.

Crotalaria showed resistance to a wide variety of nematodes. But its practical value as a cover crop is questionable because of the danger of poisoning livestock that feed on the

foliage and because of poultry toxicity from seed that can become mixed with grain feed.

Millet and sudangrass, frequently used as soil conditioning crops, increased soil populations of many destructive nematodes. When grown before tomatoes, these cover crops caused reduced stands, poor quality, and irregular growth patterns because of increased populations of ectoparasitic nematodes.

Coastal bermudagrass was resistant to root-knot nematodes, but it increased populations of other kinds of nematodes, especially the destructive sting nematode.

Beggarweed, generally considered root-knot resistant, was susceptible to the Northern root-knot nematode but was resistant to all other species of root-knot nematodes commonly found in the South.

The scientists will continue their research investigations to determine whether marigolds can be recommended as an effective nematode-reducing cover crop.☆

South American marigolds were more effective in reducing populations of plant-parasitic nematodes in soils than any of the seven cover crops evaluated by the scientists.



Against Nematodes . . .

* CHEMOSTERILANTS ARE EFFECTIVE IN GREENHOUSE

■ Chemosterilants used in laboratory and greenhouse tests have reduced populations of nematodes—some as much as 95 to 100 percent—by preventing their reproduction.

ARS scientists—apparently the first to use chemosterilants against nematodes—plan to continue their studies to determine whether the materials are safe and effective under field conditions.

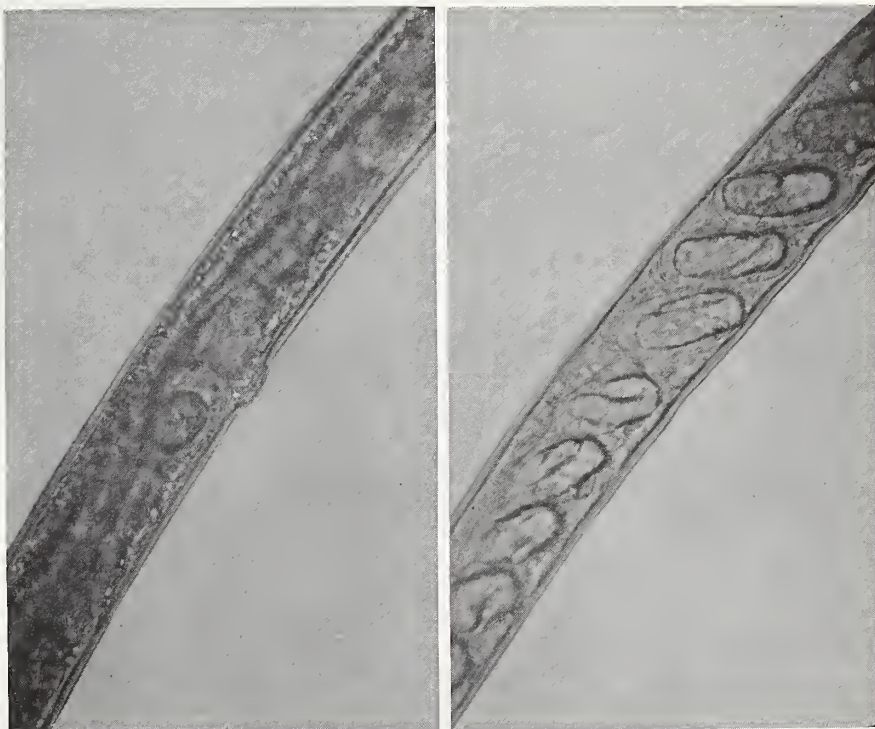
Chemosterilants have been successful in field tests in sterilizing a number of insect species, but they may not be as effective against nematodes in the field because nematode migration is so restricted. And in certain nematode species, the males are not required for reproduction.

In preliminary tests at Orlando, Fla., ARS nematologists Julius Feldmesser and R. V. Rebois determined the effect certain chemicals have on nematodes. ARS chemist Morton Beroza of Beltsville furnished the chemicals and advice on their use.

The test chemicals included some that sterilize insects and others that regulate plant growth. Some of the most effective chemicals reduced nematode populations 95 to 100 percent.

The chemical tretamine and several related materials reduced populations of two genera of nematodes, *Panagrellus* and *Rhabditis*, which are non-parasitic on plants and which are standard test organisms in nematocide evaluation work. Tretamine has been used experimentally to sterilize the house fly and the screwworm fly.

Root knot and burrowing nematodes in plant roots were controlled by several chemicals with azine configurations—and several with azi-



The female saprophytic nematode (left) shows a disfunctional uterus and nonviable egg caused by exposure to 2.5 p.p.m. of a test chemical for 3 months. The untreated female (right) contains embryonated eggs. Both nematodes, identical in age, are at the same stage of embryonic development.

ridinyl hydroquinone and halogenated amine configurations. These chemicals also controlled the two test organisms.

Microscopic examination of surviving as well as dead nematodes showed that exposure to the chemosterilants inhibited development of reproductive organs and caused degeneration of reproductive organs that were already mature. Populations of treated nematodes declined gradually because of reduced reproduction.

In other studies, the scientists compared the effects of the chemicals on male and female nematodes—and on

nematodes in various stages of development. They found that both sexes were most susceptible to the chemicals in the larval stage and that adult females were more susceptible than adult males.

The ARS scientists now are in the process of planning additional studies that will be directly related to learning more about *how* chemicals sterilize nematodes. In addition, these investigations by the researchers will also be geared to determining more about the safety and effectiveness of the chemicals under practical conditions. ☆

Cherry harvester shakes fruit into a catching frame, which is self-propelled and comes in two parts for maneuverability. Cherries roll onto a conveyor belt and are deposited into a tank of chilled water for transporting to processors.

A STUDY IN AUTOMATION



Red tart cherry harvesting and processing undergo revolutionary changes

■ Automation is revolutionizing the red tart cherry industry, beginning in the orchard with mechanical harvesters and culminating in the cannery with electronic processing equipment.

First tried in a Michigan orchard in 1959, harvesters that mechanically shake cherries from the trees have been improved every year since and are gaining a vital place in the industry. Last year about 100 of them harvested 12 million pounds of cherries in U.S. orchards; this season over 150 are in service.

Working in cooperation with Michigan State Agricultural Experiment Station, two groups of ARS scientists are largely responsible for developing these machines and for encouraging their acceptance by cherry growers and processors alike.

A group of agricultural engineers at Michigan State University, headed by J. H. Levin of ARS, has been seeking more efficient and economical methods of harvesting cherries. R. T. Whittenberger and other biochemists at the Eastern utilization research laboratory near Philadelphia have been carrying out fundamental research on the structure, composition, and physiology of cherries.

Findings by the biochemists—that

bruising is the principal cause of deterioration in cherry quality—indicated that bruising could be reduced by carefully shaking the cherries from the tree onto a suspended net. The engineers recognized the saving in labor that would be realized if the shaking could be mechanized.

Joining forces, the two groups worked with equipment manufacturers and a few interested growers and processors to develop and improve tree shakers and devices to catch the falling cherries. Subsequent models were much more maneuverable, avoided bark damage, and were equipped with an inertia-type shaker attached to the catching device instead of to a tractor. This method concentrated the vibration on the tree and vibrated the trees at a higher frequency, removing more fruit and causing less bruising.

Even with these improvements, however, mechanical tree shakers usually cause more damage to cherries than hand pickers.

As a result, more efficient cushioning materials are being sought for shakers and catching frames. And the effect of the bruising that does occur is being minimized by transporting cherries in cold water, a practice

originally proposed by ARS engineers. The cold water retards skin discoloration (scald) in bruised cherries.

Levin and Whittenberger have recommended streamlined handling practices to reduce bruising in processing plants. In addition, they helped introduce two important pieces of processing equipment—electric sorters and destemmers.

Sorting machines, developed in 1962, pick up cherries individually by vacuum for electronic inspection, thus saving time and money over hand sorting. Although effective in eliminating severely blemished and scalded cherries, the electric sorters often pass cherries with stems attached or with poor color. And they inadvertently reject a slightly higher percentage of good cherries than hand sorters do.

The 93 electric sorters used last year varied in performance, but their average operating cost of \$4.85 per ton contrasts with a cost of \$7.65 per ton in 1962 for hand sorting.

The excessive number of stems that remain attached to machine-harvested cherries slows down belt sorting, so four different types of mechanical destemmers were tried in Michigan canneries last year. They removed 87 to 98 percent of the stems.★

Bright light prevents damping-off

Seeds germinated and grown indoors may resist damping-off and develop into sturdier plants if they are kept in a bright light continuously for the first 3 weeks, ARS research indicates.

Plant pathologist C. A. Thomas found that a safflower variety that is ordinarily susceptible to damping-off was resistant when germinated and grown under continuous light. This treatment also increased the resistance of sesame, which normally is highly susceptible to the disease.

Thomas believes light will probably control damping-off in other plants, too.

This research, at Beltsville, Md., was designed (1) to test the effects of environment on the resistance of two varieties of safflower to the fungus *Phytophthora drechsleri*, which causes damping-off, and (2) to develop a method for easily determining the susceptibility or resistance of new safflower varieties.

When Biggs, a highly resistant variety, and Utah 1421-9-16, a susceptible variety, were germinated and grown under 1,000 foot-candles of continuous light for 3 weeks, both varieties were resistant to inoculations of the damping-off fungus. Under normal daylight in the greenhouse, the Utah strain was susceptible to the fungus; with less than daylight—only 100 foot-candles 8 hours per day—both varieties were susceptible.

Previous research has shown that 2-week-old seedlings are more resistant than 1-week-old seedlings, and the older seedlings have more calcium and pectic substances in the hypocotyl—

that part of the seedling between the root and the cotyledons. High-intensity, continuous light apparently increases resistance by speeding up the accumulation of calcium and pectic substances—in effect making the plants age faster.

The plants grown under continuous light were also shorter, stockier, and healthier looking than typical indoor-grown plants that receive periodic exposure to artificial light.

Measuring a beef-carcass pyramid

How is a steer's body like the Washington monument? They both are pyramids. In the Washington monument, this is easy to see. In a steer, it takes a little more imagination.

The concept has paid off, however, in evaluating both live animals and whole carcasses in recent ARS research. That's because the geometry of the carcass seen as a pyramid is directly related to weight and composition.

"We can take four measurements on the carcass or live animal," says J. W. Thornton, a statistician at the ARS Meat Quality Laboratory, "and from these four determinations we can make a pretty reliable estimate of the weight and amount of lean meat in the round, loin, rib, and chuck. These are the most valuable cuts of a carcass."

The measurements needed are length from first rib to aitch bone, chest depths at the first and seventh ribs, and shoulder width at the first rib.

The measurements make possible an objective estimate of carcass value. On live beef cattle, the tape measure

can help in selecting those animals for breeding stock that will transmit carcass characteristics most valued by the consumer.

Thornton is confident that he can find more refined measurements, which can predict carcass value even more accurately than is now possible, when used in the proper conversion formula. Work on these refinements is now underway.



Measurements needed are length from 1st rib to aitch bone, chest depths at the 1st and 7th ribs, and shoulder width at the 1st rib.

AGRISEARCH NOTES

We're gaining on hog cholera

We're winning the campaign to wipe out hog cholera—but the fight isn't over yet.

That, in a nutshell, sums up the situation in the cooperative State-Federal hog cholera eradication program on June 30, the end of fiscal 1965. Goal for a "hog cholera free" United States is 1972.

The eradication program is divided into four phases, each of which represents a gradual buildup in a State's fight against hog cholera until it has eradicated the disease (AGR. RES., June 1964, p. 12).

By the end of fiscal 1965—just 2½ years after the program got underway—all but 9 States and Puerto Rico had passed the preparatory Phase I of the program and had reached Phase II. The goal is for all States to reach Phase II or higher by the end of 1965. Of the 42 States which had already achieved this goal, 5 had advanced to Phase III, 7 were in Phase IV, and 1 State—Vermont—had been declared hog cholera free.

There were 1,108 confirmed outbreaks of cholera during fiscal 1965, compared to 1,118 the previous year—a drop of about 7 percent. Broken down by quarters, total outbreaks for fiscal 1965 are as follows: 352, 232, 194, and 330. The big jump in the fourth quarter—following the previous steady decline—was due to a serious epidemic in Georgia, where 155 outbreaks were reported during May and June. Eradication officials

cite this as an example of what can happen when an eradication program reduces the incidence of hog cholera, and producers become complacent before the disease is completely wiped out.

In other parts of the country, outbreaks of hog cholera continue to drop. The 13-State midwestern "hog belt"—stretching from Michigan, Ohio, and Kentucky on the east to the Dakotas, Nebraska, and Kansas on the west—showed a 37-percent decrease in confirmed outbreaks during fiscal 1965. Progress in these States, which contain 80 percent of the Nation's hogs, was even more striking for the last 6 months of the year: 160 confirmed outbreaks were reported, compared with 359 for the same period a year earlier.

Needed: 1 bee per 100 flowers

Cantaloup growers have long associated frequent bee pollinations of individual flowers with high fruit yield, but they didn't know—until now—how many bee visits per flower were necessary for greatest melon yield.

ARS entomologists S. E. McGregor and M. D. Levin and University of Arizona horticulturist R. E. Foster kept careful track of visits paid by bees to perfect flowers (those with both male and female parts, capable of developing fruit).

They correlated the number of visits with the percentages of fruit set and marketability of the melons produced. They then determined the ratio of bees

to flowers needed to insure maximum yield of high grade fruit: at least 1 bee for every 100 flowers.

The researchers bagged some flowers to exclude bees, exposed others to specific numbers of bee visits, and allowed still others to remain exposed throughout the day. Then after 15 days they inspected 618 perfect flowers. Of 73 bagged flowers, only 1 developed into a marketable melon; of 107 left exposed all day, 24 saleable fruits were produced.

The scientists controlled bee visits—from 1 to 18—to 438 flowers. Of 325 flowers that were shed without setting fruit, bee visits averaged 6.3 times. Flowers that set fruit, but developed into culls later, had been visited 8.2 times, and flowers that produced high-grade melons, 9.1 times.

Ideally, each perfect flower should receive at least 12 visits, the scientists say. Not only is there then greater likelihood of fruit production, but the fruit will also weigh more.

In hotter, drier areas like Yuma, the researchers observed that cantaloup flowers may be receptive to pollination only for very brief periods of time—in some cases perhaps only minutes. Thus a high bee population will help to insure sufficient visits during receptive periods.

The investigators recommend that bee colonies be placed in the cantaloup fields in places where the ratio of bees to flowers is less than 1 to 100, so that each perfect flower (1 in 10) may receive the 12 visits needed for maximum production.